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MONTANA ADVISORY COUNCIL ON
SCIENCE AND TECHNOLOGY

REPORT OF DRAFT RECOMMENDATIONS

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TED SCHWINDEN, GOVERNOR

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HELENA, MONTANA 59620-0401

November 2, 1984

The Honorable Ted Schwinden
Governor of Montana
State Capitol
Helena, MT 59620

Dear Governor Schwinden:

On behalf of the Governor's Advisory Council on Science and Technology, I am pleased to submit to you this Report of Draft Recommendations. Contained herein are the Advisory Council's draft recommendations, including the major draft recommendation for a 10-year, private and public investment program to insure the application of technology to Montana business and industry, and to foster the growth of advanced technology development in Montana.

Representatives of the business and academic communities are very interested in a cooperative investment program with the state of Montana. The Advisory Council's major draft recommendation would establish a desirable program of new alliances and shared investments in the application and development of technology within Montana.

The Advisory Council will submit a final report to you and the Legislature following a public meeting on these draft recommendations to be held on November 15, 1984, in Helena.

Sincerely,

A handwritten signature in cursive script, reading "Raymon F. Thompson".

RAYMON F. THOMPSON, CHAIRMAN
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RFT:jc
Enclosure

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CHAPTER I. EXECUTIVE SUMMARY

BACKGROUND

Dramatic changes in the economic structure of the Nation has led to the displacement of many traditional industries and concerns about the future. Montana has been severely affected as well. However, greater application of technology by existing businesses and development of new advanced technology business and industry is seen by many as having the potential to make a positive, long-term contribution to Montana's economic future. The revitalization of traditional industries through the use of technological advances together with the development, expansion and attraction of advanced technology firms, is a major opportunity for new jobs and for a more diverse and growing economy.

To attain these economic improvements, however, will require bold new initiatives, operating in a spirit of public and private cooperation, which combine the talents and resources of business, industry, education, labor and government. The members of the Advisory Council on Science and Technology, based on their thorough study of the state and national situation and public input obtained from subcommittee participants, believe that combined public and private action must be started if Montana desires to be competitive and nurture technology development to secure a better economic future.

ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY

Governor Ted Schwinden, on October 19, 1983, established the Advisory Council on Science and Technology to first, help existing Montana businesses, farmers and ranchers, professionals, and industrialists use technology to compete in an advanced technology economy, and second, support new advanced technology development in Montana. The Governor requested that the Advisory Council examine

the possibility of establishing a partnership between business, state government, colleges and universities, and vocational training centers having the purpose to ensure that research and technology are put to practical use in Montana's economy.

SUBCOMMITTEES

Ad-hoc subcommittees were a major tool helping the Advisory Council evaluate the present economic situation, explore opportunities and ideas for using science and technology advantageously in economic development, and to prepare recommendations. Nine informal subcommittees were established with over one hundred participants. Subcommittees worked in the following areas: Agriculture Technology; Biotechnology; Computers, Electronics and Materials Science; Energy and Energy Conservation; Financing and Commercialization of R&D; Forestry Technology; Information Dissemination; Mineral Technology; and Technical Education. The subcommittee's suggestions, ideas, and conclusions guided formulation of Advisory Council's draft recommendations.

FINDINGS

The conclusion of the Advisory Council on Science and Technology is that timely, shared public and private sector investment to stimulate scientific investigation and technology use and development within the state represents a significant opportunity for Montana business to become more productive and competitive and to make Montana more attractive for the start-up, and expansion of advanced technology firms.

The Advisory Council believes that a course of action should be undertaken immediately to revitalize and diversify the state's traditional strengths in

agriculture, minerals, energy, forest products and small manufacturing as well as encouraging economic growth in new emerging areas such as biotechnology, electronics and computer sciences, communications and information sciences, and materials science.

DRAFT RECOMMENDATIONS

A Science and Technology Development Institute: A Major Draft Recommendation

Public and private resources should be combined, organized, and invested in an alliance organization to provide scientific and technological support for Montana industries and businesses to improve their competitiveness and to bring new technological opportunities to the state. Other states are taking similar actions and are investing significantly in indigenous technological development. The Advisory Council believes that Montana too, must take bold steps. Therefore, a major partnership program to foster technological development in Montana is being recommended.

Organization

Proposed is a Science and Technology Development Institute operating as an alliance of business and industry, universities and colleges, vocational education, labor, and state government. The purpose of the Institute would be to facilitate shared investment in promising ideas, programs, and projects proposed by private and public organizations and institutions that would promote technology use and development having significant economic potential for Montana. An Organization Structure for the Institute is shown as Figure 1, page 26.

Programs

The Science and Technology Development Institute would have four complementary investment programs:

1. Matching Research Investments

- Project oriented.
- Institute would jointly invest in research project of industry, university and colleges, and other research and development organizations.
- A match of 100% required from cooperators.
- Only Research and Development (R&D) projects having potential for commercial application leading to in-state jobs and investments would be supported.
- An equitable portion of royalties and license fees would accrue to the Institute.
- Examples: Industry research and development, university sponsored and contract R and D; federal Small Business Innovation Research program (SBIR) matching grants, etc.

2. Research Capability Investments

- Program oriented.
- Institute would invest in the creation or strengthening of in-state, private and public R&D capabilities having potential for expanded economic development.
- Preference given if matching funds are available.

- Priority given for investments supporting partnership arrangements between business and industry and University System units.
 - Examples: Support for industry - university research centers and laboratories, research and development consortia, other cooperative R and D arrangements, research faculty, graduate fellowships, instruments and equipment, industry-university faculty exchanges, etc.
3. Technology Transfer and Technical Assistance Investments
- Invest in programs transferring technology to business and industry, training centers, schools, and the general public.
 - Preference given if matching funds are available.
 - Examples: Business - university technical councils, teacher exchanges with industry, technology literacy programs, industrial training in new technologies, small business problem solving, access to technical information, etc.
4. Seed Capital Financial Investments
- Investments would provide financial leverage to encourage private sector seed capital formation (early stage financing) which presently is difficult to obtain and, therefore, restricting new businesses based on innovation.
 - Montana Economic Development Board would administer this financial program for the Institute.
 - Returns on investment would accrue to the Institute.

- Financial investment will be considered only if financial intermediary has equal dollars-at-risk.
- Examples: Equity investments in start-up companies, royalty investments in product development projects, etc.

Criteria for Investment

Three criteria would guide the investment made by the Institute:

1. Contribution to economic development and job creation.
2. Quality of work or service performed.
3. No duplication of existing facilities on-going programs, projects, or work.

A competitive review process would be used to select all investments.

Targeted Technologies

The Advisory Council targeted eight technologies believed to have the highest potential for enhancing economic growth. These technologies support existing business and industry as well as new industry-based on emerging technologies.

- mineral technology
- agricultural technology
- forestry technology
- energy technology
- materials science
- information services
- biotechnology
- microelectronics and computer sciences

Other technologies, however, would be eligible for investment.

Annual Institute Budget

The estimated annual Institute budget is six million dollars (\$6,000,000) over a ten-year period, for a total of sixty million dollars. Additionally, matching is expected at forty percent or forty million dollars. Together, the Institute investment plus matching, creates a 10 year, one hundred million dollar technology investment program.

The Advisory Council believes this amount is reasonable and necessary to make significant improvements to the economy from technological development. The Advisory Council also believes that ten year funding of the Institute and its economic development investment programs should be from the Coal Tax Trust Fund. A proposed annual budget for the Institute is shown in Table 2, page 32.

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The Advisory Council, in addition to its draft major recommendation for a Science and Technology Development Institute, has six other draft recommendations.

Support for University System Budget Modifications

The University System and its units are proposing new or expanded programs that would assist and encourage research and technological development and provide small business support. The Advisory Council supports these modifications:

University of Montana

- Forestry and Conservation Experiment Station - Expand mission-oriented forest research. Requested biennium budget - \$431,610.

- Masters of Business Administration at Eastern Montana College-
Expand the graduate program in Business Administration to
include offering a masters degree at Eastern Montana College at
Billings. Requested biennium budget - \$482,013.
- Biological Station - Expand research and instrumentation at
the Flathead Lake, Valley Bay Research Laboratory. Requested
biennium budget - \$225,200.

Montana College of Mineral Science and Technology

- Energy and Mineral Technology Research - Strengthen research in
technology areas of coal, petroleum and hard-rock mined-land
reclamation. Requested biennium budget - \$533,092.

Montana Bureau of Mines and Geology

- Mineral and Groundwater Information Services - Build an inter-
active ground-water and mineral resource information system.
Requested biennium budget - \$160,600.
- Coal Geology - Begin systematic coal quality investigations
critical to assessing and end use or appropriate beneficiation
processes. Requested biennium budget - \$220,900.
- Hard-Rock, Mined-Land Reclamation - Develop a reclamation
research and information program. Requested biennium budget -
\$191,800.

Montana State University

- Engineering Experiment Station (EES) - Expand research, in areas
of (a) public works engineering; (b) power and communications

systems engineering; and (c) materials engineering. Requested biennium budget - \$1,067,380.

- Water Resources Center - Provide a required state match to federal funding. Requested biennium budget - \$120,000.
- Agricultural Experiment Station - Expand research to improve the quality and type of agricultural end products. Requested biennium budget - \$398,000.
- Cooperative Extension Service - Support for one position in business development assistance. Requested biennium budget - \$46,805.

University System

- Reduce Indirect Cost General Fund Offset - Reduce the research indirect cost reimbursement to the general fund so that the originating institution will retain 100 percent rather than 15 percent of indirect costs.

The Advisory Council also supports capital investments within the University System in support of research, scientific and technical education, and technology development. This includes support for the Engineering and Physical Sciences Complex at Montana State University, and the multi-use, Technical Building at Northern Montana College at Havre.

Commercialization of University Research

The University System should (a) examine existing patenting, licensing, and commercialization services and expand and enhance these services within the

entire system, and (b) develop a system-wide policy allowing Montana firms to have first opportunity to commercialize University research.

Science and Technical Education

This recommendation requests strengthening in the following areas relating to scientific and technical education and training: teacher training, vocational education, skills development, industrial involvement, career opportunities, information networks, and continuing education.

Research Technology Parks and Technology-Based Incubator Facilities

The proposed Science and Technology Development Institute and the Department of Commerce should evaluate the feasibility of research/technology parks and technology-based business incubator facilities. Investments from the proposed Institute's research capability program should be made available for feasibility and initial planning for these facilities.

Telecommunication Corporation

A temporary Committee should be formed by the proposed Institute and funded by the proposed Institute's technology transfer and technical assistance program to plan, develop and launch a new private, non-profit corporation. The corporation would inventory, plan, coordinate, and pool available telecommunication resources both public and private into an efficient system. Committee should be established for two years and receive \$200,000 funding.

Research Chairs to Support Cooperative Research

Establish within the University System a program of seven distinguished research chairs to support the research needs of existing industry as well as emerging

advanced technology industries. Estimated cost would be \$700,000 annually (\$100,000 per chair) with funding from the proposed Institute's research capability investments program. Private sector matching is expected.

CHAPTER II. BACKGROUND

TEMPORARY COMMITTEE EFFORTS

A temporary committee to sponsor creation of a committee (board) on science and technology was established informally in 1982 as preplanning for the "Build Montana" Program. The temporary committee recommended the creation of a Board of Science and Technology having authority to (1) apply for and accept grants of money from private and public sources, including appropriations from the legislature, and (2) award grants and contracts to individuals, business entities, public agencies, and colleges and universities to do research and development projects primarily in Montana that complement and support economic development.

GOVERNOR'S "BUILD MONTANA" PROGRAM

Governor Ted Schwinden, as part of his "Build Montana" Program provided to the 1983 Legislative session, recommended establishment of a nine member Science and Technology Council to be attached to the Department of Commerce. The Council would develop strategies and implement plans to obtain public and private funding for continuous support of multi-year research and development projects and programs which would enhance economic development. A biennium budget of \$197,414 was proposed.

LEGISLATIVE ACTION

The 1983 Legislature appropriated \$100,000 in House Bill 1, for the creation of an Advisory Council to advise the Department of Commerce on the applications of science and technological research in the development and implementation of economic development programs.

GOVERNOR'S EXECUTIVE ORDER CREATING THE ADVISORY COUNCIL

The Governor, by Executive Order No. 13-83, in response to House Bill 1 passage, established on October 20, 1983 an Advisory Council on Science and Technology and appointed eleven members. The purpose of the Council is to study the science and technology resources existing in the state and their potential, and use this information for developing long and short-range plans for economic development. The eleven Advisory Council members represent a cross-section of scientific, industrial, financial, and agricultural backgrounds.

MISSION

Governor Schwinden, speaking at the first meeting of the newly created Advisory Council on Science and Technology, October 31, 1983, charged the members with these comments:

"... the first order of business for this Council should be applying scientific technologies to existing Montana businesses and industry. Helping Montana businesses, farmers and ranchers, professionals and industrialist use state-of-the-art technology in order to compete in tomorrow's high-tech oriented business world must be our primary goal. Only after that should we consider starting up new technology-based businesses in Montana."

The Governor requested recommendations to do the following:

- expanding and using the capabilities or research universities in partnership with business and industry;
- applying science and technology to Montana businesses and industries to help improve their productivity and completeness;

- assuring that students at all educational levels receive necessary technical and science education; and
- training and retraining workers in necessary skills to obtain work in business and industry.

GOALS

The Advisory Council on Science and Technology, in response to the direction given by the temporary committee, and the directives of the legislature and the Governor, adopted the following objectives:

- Develop strategies to transfer and share research and technical information with existing businesses to increase their use of technology.
- Suggest ways for combining resources of government, business and industry, and academia to strengthen research capabilities and establish research centers.
- Develop mechanisms to encourage innovation and support its commercialization in Montana.
- Propose state priorities in scientific and technology areas.
- Suggest ways that education and training can reflect scientific and technology employment needs.
- Develop a strategy to do public and private financed cooperative research and development supportive of expanded investment and employment in Montana.

- Determine the appropriateness of research and technology parks.
- Develop a partnership organization, either public or private, to encourage, guide, coordinate, and help finance the use of technology and advanced technology economic development.

SUBCOMMITTEES

The Council members, at their initial meeting held on October 31 and November 1, 1983, choose to obtain information and ideas from a broad spectrum of people. To accomplish this, informal subcommittees were formed with each subcommittee to be headed by an Advisory Council member. Nine subcommittees were organized.

- Agriculture Technology, Chair: Pat Iman
- Biotechnology, Chair: Barbara Wright
- Computers, Electronics, and Materials Science, Chair: Robert Swenson*
- Energy and Energy Conservation, Chair: Peter Antonioli
- Financing and Commercialization of Research and Development, Chair:
Richard Bourke
- Forestry Technology, Chair: Gareth Moon
- Information Dissemination, Chair: John J. Jutila
- Mineral Technology, Chair, Edward Bingler
- Technical Education, Chair: Leland Walker

*Robert Swenson is a resource person to the Advisory Council

Over one-hundred people participated on these subcommittees and some 24 meetings were held. A listing of participants is provided in Appendix B. Reports of

subcommittee's findings and proposals were provided to the Council. Summaries of these subcommittee reports are provided in Appendix C.

The major draft recommendation as well as the other draft recommendations of the Advisory Council responds to ideas and suggestions developed by the nine subcommittees.

CHAPTER III. DRAFT MAJOR RECOMMENDATION
A PROGRAM FOR INVESTMENT IN TECHNOLOGY DEVELOPMENT

SITUATION

Dramatic changes in the economic structure of the Nation has led to the displacement of many traditional industries and concerns about the future. Montana has been severely affected as well. According to the Montana Economic Reporting and Forecasting System, there are fewer jobs now in Montana than in 1979; the gap between Montana and U. S. per capita income is widening, and Montana's economic base will be smaller in 1985 than in 1979. However, greater application of technology by existing businesses and development of new advanced technology business and industry is seen by many as having the potential to make a positive long-term contribution to Montana's economic future. The revitalization of traditional industries through the use of technological advances together with the development, expansion and attraction of advanced technology firms, is a major opportunity for new jobs and a more diverse and growing economy.

To bring about economic improvements, however, will require bold new initiatives, operating in a spirit of public and private sector cooperation, which combine the resources of business, industry, education, labor and government. States throughout the nation are anticipating an economy based upon greater technical innovation and more reliance on the value of knowledge-based economic activity, and they have already taken positive steps to respond to this shifting economy. The members of the Advisory Council on Science and Technology, based on their thorough study of the national situation and public input obtained from subcommittee participants, believe that action must also be taken in Montana to secure a better economic future and to prevent further deterioration.

To achieve results, the efforts and resources of the state must be focused on those technologies that will benefit traditional industries and have the greatest chance of succeeding and being transferred into positive economic growth in Montana.

RECOMMENDATIONS

Create A Science and Technology Development Investment Program

The Advisory Council on Science and Technology's major and most important recommendation is the creation of a Science and Technology Board and Institute. The Institute's mission would be to improve the state's economy by investing in partnership with the private sector in public and private programs and projects advancing technology use and development in Montana. Investments would help existing businesses obtain, use and benefit from scientific and technological advances, and would make the state more desirable and competitive as a location for starting and attracting technology-based businesses.

The Science and Technology Development Institute would have major responsibilities in the following areas:

- a. administration of the Montana Science and Technology Development Fund with four investment programs
 - research capability investments, including establishing University research faculty chairs
 - matching research investments
 - technical assistance/transfer investments, including creation of a private, non-profit Telecommunication Corporation

- seed capital financial support program
- b. help formulate policy and develop mechanism to foster utilization of scientific knowledge and advanced technology in traditional and emerging business firms;
- c. provides services to existing businesses in Montana including:
 - assure, in cooperation with others, that information related to advanced technology research and development, manufacturing and financing is obtained and accessible on Montana businesses, research organizations, researchers, research projects, and others;
 - inventory existing scientific data bases services and provide instructions on how firms and individuals can gain access to those services. Investigate opportunities for expanded opportunities in this area;
 - encourage and sponsor, in cooperation with other private and public organizations, conference, symposia and trade show of interest to firms, entrepreneurs, and financial institutions;
 - provide assistance to firms wishing to obtain grants from the Federal Small Business Innovations Research (SBIR) programs; and
 - other assistance as necessary to encourage innovation and business development.

Targeted Technologies

The Council recommends the following technologies as those initially targeted for investment by the proposed Science and Technology Development Institute. Further refinement of these technologies will be necessary to further focus technology support. However, to provide flexibility, all technologies (both those existing and as yet unknown), not just targeted technologies, shall be eligible for Montana Science and Technology Development Institute support.

Mineral Technology -- Montana's abundant natural mineral resources face increasingly stiff foreign competition and high transportation cost. Among the goals identified as crucial to making mineral resources competitive are:

1. Coal characterization and processing
2. Improvement in efficiency of oil and gas extraction
3. Improvement in mineral concentration technologies
4. Improvement in mineral exploration technologies
5. Other

Agricultural Technology -- Montana produces an abundance of agricultural products, over 50% of which must compete in an uncertain world market. The remainder must compete on a domestic market with products that are grown where shipping costs are lower and/or production unit costs are also lower. Additionally, on the national scene fewer and fewer producers are needed to supply the necessary food and fiber. To overcome the disadvantages inherent in these facts research and technological development must focus on:

1. Developing product processing facilities in the state;
2. Do more product development

3. Provide necessary expertise to Montana entrepreneurs seeking to establish enterprises based on increased utilization and/or value enhancement of agricultural products.
4. Other

Forestry Technology -- The key to maintaining and improving the economic return from forest resources are:

1. Enhance growth and utilization processes
2. Better utilization, management, and protection of second growth forests
3. Intensify cellulose products and wood chemistry research
4. Improve and create new harvesting technologies
5. Establish a firm multiple-use land base
6. Other

Biotechnology -- A common thread that winds through many of the other technologies (agriculture, forestry, mineral, energy) is the use of biotechnology. The goals identified with particular relevance to Montana were:

1. Genetic Engineering of plant and animals
2. Immunology
3. Toxic water treatment
4. Mineral recovery
5. Synthesis of new chemical products
6. Other

Microelectronics and Computer Sciences -- The profound social and economic effect that electronics and computer technologies have had are undisputable.

Translating those benefits into Montana's economic system means work is necessary on the following:

1. Robotics
2. Computer Aided Design and Engineering (CAD/CAE)
3. Fiber optics
4. Communication technology
5. Applications of computer technologies to Montana businesses
6. Other

Energy Technology -- Montana's abundant energy resources require careful development to meet the expectations of the citizens for jobs, economic development and environmental protection. To enhance the utilization of these energy resources in a manner compatible with the concerns of the citizens, the following areas require research work:

1. Improvement in coal utilization (liquefaction, gasification, MHD and fluidized bed)
2. Energy conservation technologies improvements
3. Development of renewable resource potentials
4. Other

Information Sciences -- The transfer of scientific, technical and business information to the businesses and industries of Montana is crucial if local firms are to remain competitive. The specific work areas identified were:

1. Creation of adequate data bases specific to Montana
2. Access to existing data bases
3. Applications of computer software to Montana businesses
4. Other

Materials Science -- Without the building blocks of materials no technology enhancements would occur. Improvements in materials that are utilized in a modern society are essential to improving the economic viability of all of the other technologies. The key areas identified that are in need of specific research were:

1. Composite structures
2. Ceramics
3. Metal polymers
4. Alloys
5. Other

These targeting technologies will help initially set the investment agenda for the proposed Institute by focusing on those areas believed to have the highest potential to enhance economic growth in Montana.

OPERATION

The proposed Montana Science and Technology Development Institute would make investments in public and private organizations to: (1) support the performance of cooperative private/public research and development which would have economic significance, (2) strengthen the state's research capability, (3) help Montana businesses and industries utilize advanced technology in their operations, and (4) provide seed capital financing, through financial intermediaries, to entrepreneurs and investors doing early stage development work leading to new commercial applications or new business start-ups.

Investments would be used to encourage and leverage financial support by providing matching funds for projects proposed by other state entities (private

and public) that promote technological development, specifically projects aiding traditional businesses as well as encouraging new business and industry in the state. Supported business and industrial enterprise must maintain, or propose to maintain, a relevant research, development, or manufacturing facility in the state, or propose forming research and development joint ventures with in-state research and development organizations. It is expected that the investment program can achieve a 60/40 matching ratio of state funds to private and other public sectors funds.

Investments would support programs and projects that would benefit various existing sectors of the state's economy (minerals, agriculture, forestry, energy, retailing and small manufacturing) as well as expanding and diversifying the economy by supporting emerging technologies (micro-electronics, computers, biotechnology, materials science, information sciences). Other technology areas would also be eligible. All investments would be selected on a competitive basis with the proposed Science and Technology Board having final selection authority.

FUNDING

A Montana Science and Technology Development Institute's investment programs would require funding from the legislature. The Advisory Council recommends that money from the Coal Tax Trust Fund at \$6 million per year for ten years, (\$60 million total of state funds) be used. State funding would cease after ten years and the Institute could then operate from interest on the remaining principal and from royalty and license income derived from intellectual properties held. The Institute would maintain a limited royalty position on security interest in intellectual property rights in supported research and

development as necessary to fulfill fiduciary responsibilities of the Fund. Also equity investments would be made, through financial intermediaries, in start-up companies. Not every investment will be successful and produce income. Because of the matching requirement of key investment programs, the total state investment of \$60 million should leverage an additional \$40 million of private sector and other public monies.

ADMINISTRATION

A proposed Board of Science and Technology, appointed by the Governor for staggered four-year terms, would administer the Institute. Assisting the Board would be an Executive Director with minimal staff. The Board, the Executive Director, and the staff, as an administrative unit, would be known as the Montana Science and Technology Development Institute. Figure 1 shows the organizational structure of the proposed Institute.

INVESTMENT PROGRAMS

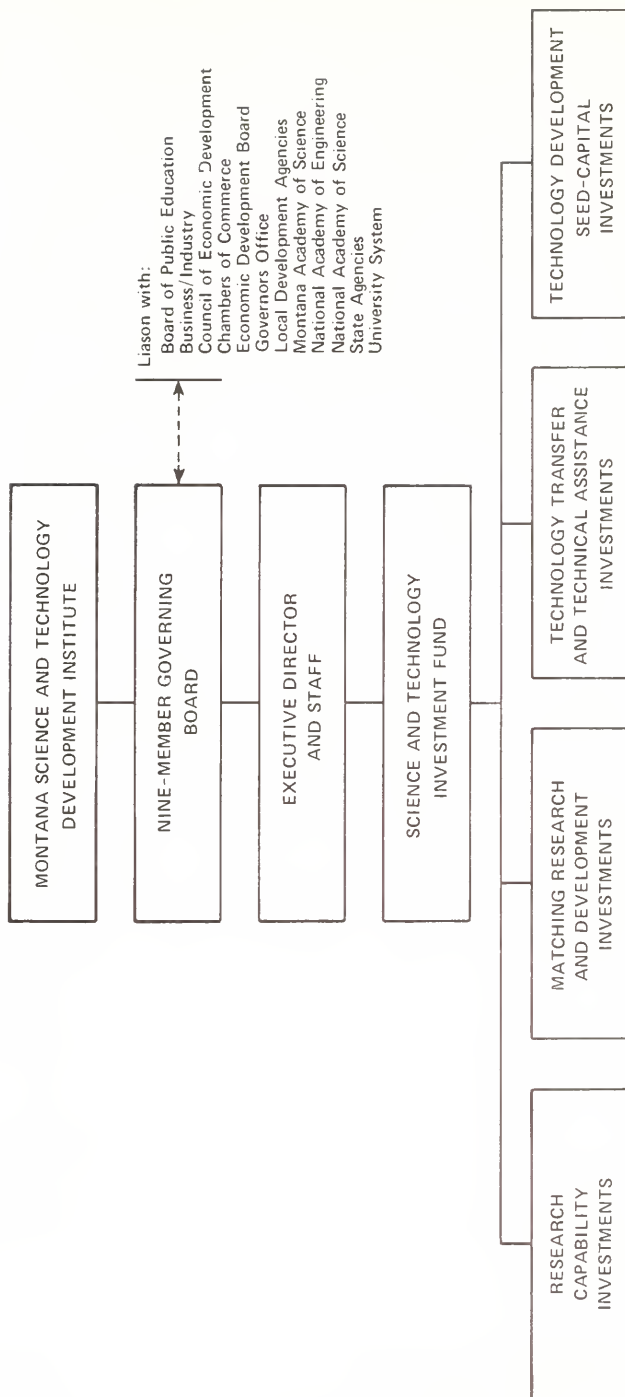
The Montana Science and Technology Development Institute would have four complementary investment programs. These programs would leverage additional private and public investment through matching requirements and preferences.

MATCHING RESEARCH INVESTMENTS

Purpose - The Institute would jointly invest in sponsored research and development projects proposed by industry, universities and colleges, and other appropriate research and development organizations. Investments would be for those research and development projects

FIGURE 1

PROPOSED STRUCTURE OF THE MONTANA SCIENCE AND TECHNOLOGY DEVELOPMENT INSTITUTE



leading to product development, commercialization and production in Montana. Proposals should be based on innovative ideas which could result in the development of business expansion, new business, and jobs in the state. Royalties and license fees from the fund's share of investment would accrue to the fund. Funds could be used to match Federal Small Business Innovation Research (SBIR) grants received by small businesses in Montana.

Matching - The fund would require a mandatory match of a dollar for each Institute dollar invested (100%). In-kind or equipment use in the project could be part of the mandatory match.

Eligibility - Montana industry and business, universities and colleges, research organizations.

Priority - Priority would be given to research and development projects that are joint partnership efforts between industry and university system units.

RESEARCH CAPABILITY INVESTMENTS

Purpose - This program would make investments to create or strengthen research and development capabilities in the state in areas having significant potential to support technology-related economic development. Investments would be for establishing research centers, research staff, equipment, operating costs; the construction of buildings or structures would not be eligible for investment. Research capability investments would be of fixed duration and would not duplicate existing research and development capability in the state.

Matching - The fund would give preference to investments that obtain at least a match of fifty cents for each fund dollar invested (50%). In-kind or equipment use may be part of the match.

Eligibility - Any legitimate research and development entity maintaining or proposing to maintain a facility in the state.

Other Priority - Priority would be given for capability investments supporting partnerships or consortiums between Montana business and industry and the university system units.

TECHNOLOGY ASSISTANCE AND TRANSFER INVESTMENTS

Purpose - This program would invest in programs providing training, assistance and information helping new and established firms, develop and manufacture new technology and to utilize technology to improve productivity and profitability. Investments will support programs providing, among other things, technical and commercialization assistance, technological training, and access to technical and business information sources. For example, Computer Aided Design/Computer Aided Manufacturing technology (CAD/CAM) can be used by Montana's small manufacturers to increase productivity; the transfer of this technology to Montana small businesses is the type program that would be supported.

Matching - The fund would give preference to investments that obtain some level of matching. In-kind or equipment use may be part of the match.

Eligibility - Any private or public Montana organization.

Other Priority - Priority would be given to investments in programs representing partnership efforts between business and industry, university units, and state and local governments.

SEED CAPITAL FINANCIAL INVESTMENTS

Purpose - This program would provide financial support to leverage private sector seed capital formation (early stage financing) for joint investment in businesses and projects at the early stages of the innovation process leading to a commercial application. Investments would be made through financial intermediaries with money-at-risk in business start-up and development projects at stages two through four of the development process shown in Table I.

TABLE I

STAGES OF DEVELOPMENT PROCESS

1. Idea
2. Proof-of-concept
3. Prototype development
4. Product development
5. Commercial application

Early stage financing has a high degree of risk but with large return on investment potential. Money for this type investment is in short supply in Montana. Entrepreneurs therefore go out of state for investment or abandon their ideas, thereby limiting or restricting entrepreneurship based on innovation.

Financial investments would be provided to applicants in participation with financial intermediaries who have their own money-at-risk. These financial intermediaries would include, but not be limited to: Montana Capital Companies, Montana-based Small Business Investment Corporations (SBICs), and Research and Development Limited Partnerships.

Investments from this program could be used to encourage equity investments in Montana small businesses who because of Federal SBIR awards have products to commercialize.

The Montana Economic Development Board because of its financial expertise would administer this program for the proposed Montana Science and Technology Development Institute under program objectives and criteria developed by the Institute.

Any return on investment to the state shall be deposited in the fund supporting the Montana Science and Technology Development Institute.

Matching - Financial investment will be considered only if the financial intermediary has equal dollars-at-risk.

Eligibility - Montana Capital Companies, Montana-based Small Business Investment Corporation (SBICs), and Research and Development Limited Partnerships with proposed investments in promising Montana business start-ups and R and D projects.

CRITERIA FOR INVESTMENTS

Three principle criteria would be used in selecting investments: 1) quality of scientific work or service provided as determined by peer review and business management review; 2) contribution to improving the state's economic well-being and creation of jobs; and no duplication of existing facilities, or on-going programs, projects, services, or work.

ANNUAL BUDGET

The estimated annual budget for the proposed Montana Science and Technology Development Institute is shown in Table II.

IMPLEMENTATION

The creation of a Montana Science and Technology Development Institute, its Board and investment fund will require legislation. It is proposed that the Science and Technology Development Institute be funded from the existing Coal Tax Trust Fund and be appropriated \$6 million annually from the Coal Tax Trust Fund for 10 consecutive years for a total of \$60 million. The Science and Technology Development Fund could after 10 years, become self-sufficient, operating from interest on principal and from accruing royalty and license income or it could cease to operate.

TABLE 2

MONTANA SCIENCE AND TECHNOLOGY DEVELOPMENT INSTITUTE
ANNUAL PROGRAM BUDGET

I.	PROGRAMS	PURPOSE	STATE FUNDS	ESTIMATED MATCHING
	Matching Research Investments	To match business and industry funds committed to research and development (R&D) having high potential to support existing business and industry.	\$2 MM	\$2 MM
	Research Capability Investments	To strengthen or create research and development capabilities in areas of potential economic significance.	\$2.5 MM	\$1.25 MM
	Technology Transfer and Assistance Investments	To establish and strengthen programs providing technology transfer and technical assistance to Montana business and industry.	\$.5 MM	----
	Seed Capital Finance Investments	Provide, through intermediary financial institutions, early stage financing. Program to be administered by the Economic Development Board	\$.75 MM	\$.75 MM
			<hr/> \$5.75 MM	<hr/> \$4.00 MM
	II. BOARD AND STAFF SALARIES, EXPENSES, AND OPERATIONS	To provide administrative funds for the Board and staff operation to include policy development, technical assistance, communications, and information services.	\$.25 MM	
	TOTALS		\$6.00 MM	\$4.00 MM

CHAPTER IV. OTHER DRAFT RECOMMENDATIONS

UNIVERSITY SYSTEM BUDGET MODIFICATIONS

Description of Problem or Situation

The units of the University System will submit program budget modifications for the 1987 biennium. Several of these budget modifications support programs of interest to the Advisory Council including appropriate research related to economic development; technical and business assistance to business, agriculture producers, and government; and an expanded graduate program in business administration.

Recommendations

The Advisory Council recommends that the Legislature support the following University System Program modification which can significantly contribute to long-term economic development:

UNIVERSITY OF MONTANA

Forest and Conservation Experiment Station -- The Mission Oriented Research Program in the Montana Forest and Conservation Experiment Station would be expanded to meet many priority needs identified by the Council on Science and Technology's Forestry Technology Subcommittee. The program wishes to increase staff by adding 7.5 FTE's; 2.5 FTE scientists and 5.0 technicians. The first year includes the purchase of harvesting and processing equipment. Research would include genetics, density manipulation in timber stands and site amelioration and other topics. The transfer of information is planned. Requested biennium budget - \$431,610.

Masters of Business Administration Program (MBA) at Eastern Montana College --

The Billings area has over 150 prospective students wanting a MBA program and who are eligible for admission. The majority of potential students have full-time employment and are unable to move.

It will take two years before enrollment sustains the program through the funding formula, therefore start-up funding is being requested. Requested biennium budget - \$482,013.

Biological Station - Yellow Bay on Flathead Lake -- Water quality is an important element in economic development. The purpose of this program modification is for maintaining the laboratory and expanding it into the region's finest freshwater research facility. Funds would supply additional staff, operation expenses, and additional instruments to raise the capability of the Laboratory to state-of-the-art. University intent is to also aggressively pursue private funds for the support of the laboratory. Requested biennium budget - \$225,200.

COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY

Energy and Mineral Technology Research -- Increased extraction and use of primary energy and mineral resources -- oil and gas, coal, precious metals, strategic and critical minerals, the industrial minerals -- provides significant economic opportunity. Realizing this economic potential depends upon the technological innovation in the mineral technology. Development and sustaining of high quality research programs to produce this innovation, requires consistent and long-range funding of research faculty and support staff.

Funding requested would strengthen three technology areas: 1) Coal research including chemical characterization, processing for sulfur and ash removal, thermal upgrading and alternative coal use; 2) Petroleum research including enhanced-oil-recovery technology, stratigraphic and physical analysis of petroleum source and reservoir rocks, tectonic analysis of the Overthrust Belt, development of deep crustal models; and 3) Hard-rock, mined-land reclamation including geotechnical research for reclaiming abandoned-mine lands, ground-water impacts and constraints on reclamation, biological impacts from mine reclamation, microbiological technology for mine-waste detoxification and revegetation for hard-rock mined land.

These modified funds will provide significant new opportunities to develop innovative technology to the Montana mineral industry. Requested biennium budget - \$533,092.

MONTANA BUREAU OF MINES AND GEOLOGY

Mineral and Groundwater Information Services -- Information on Montana's mineral and ground-water resources continues to accumulate at numerous locations, by various agencies. This data is often inaccessible and incompatible between users. This program modification would provide staff, operating support and the necessary electronic equipment to develop a Resource Data Management System. This system will utilize existing data to build a ground-water and mineral resource information system, to respond to public inquiries regarding mineral resource potential, location, and quality. Access to such information is critical to many land-use and mineral management decisions. Requested biennium budget - \$160,600.

Coal Geology -- The Montana coal industry is important to the state's economy. Average annual production of nearly 30 million tons per year of low sulfur, subbituminous coal provides nearly \$90 million annually in severance taxes, several thousand jobs, and significant capital investment.

Concern over coal use as a factor in acid precipitation, and the intensifying research and technology development programs in eastern coal-producing states, are increasing demand for information and the quality and distribution of Montana coal resources. Coal quality investigations provide measures critical to assessing end use or appropriate beneficiation processes. If Montana coal producers are to meet the technological challenge posed by intensive research and development programs in other coal-producing states, and avoid further market erosion, research in coal characterization must be expanded.

This program modification would provide two coal geologists to begin coal quality investigations and the collection of subsurface coal samples. Results will be published as profiles of coal characteristics including the distribution, by coal seam and area, of quality factors, information essential to expanding use through technological innovation. Requested biennium budget - \$220,900.

Hard-Rock Mined-Land Reclamation -- Both government and the private sector are committed to reclamation. Reclamation practice must be tailored to specific conditions at individual sites, therefore, reclamation research must be based upon knowledge of local geologic and hydrologic conditions.

This request would develop a scientifically-based, practical hard-rock mined-land reclamation research and information program which would 1) develop improved and less costly treatment technology for historic disturbed

mine lands, and 2) provide an improved information base to support development of better and potentially less environmentally damaging new mines in Montana's characteristic climate and terrain.

This request would provide one hydrogeologist and one geological engineer to conduct essential research specifically to hard-rock mines. Program goals include providing mine developers with geologic and hydrologic data prior to mine development, training and information services in reclamation practice, design and maintenance of ground-water monitoring and modeling systems for impact prediction, and recommendations for identification, inventory and mitigation of mined-land subsidence. Requested biennium budget - \$191,800.

MONTANA STATE UNIVERSITY

Engineering Experiment Station (EES) -- Three program areas have been targeted for support in this modification request. They are: public works engineering, power and communications systems engineering, and energy systems and materials engineering. They are areas that can serve economic development.

Public Works Engineering -- Infrastructure decay in Montana and nationally has reached alarming proportions. Estimates of costs to repair facilities range from tens of millions of dollars in Montana to tens of billions of dollars nationally.

The EES will provide education, service and technology development in the areas of: transportation, municipal water supply, and environmental engineering. One project will study the feasibility of renovation of deck truss bridges in Montana. Another study proposed will develop models of water usage patterns in for use in the design and operation of municipal water systems.

Power and Communication Systems Engineering -- The escalating costs of fossil fuels require optimized operations of every power entity. The Engineering Experiment Station will provide the advanced planning tools which the electric power industry needs to meet the increased demands for electrical energy while satisfying environmental concerns and financial restrictions. Tools to be developed include improved conventional generating, transmission and distribution facilities, together with new concepts in power generation, such as solar and wind-powered systems.

Other projects include development of a low cost "electronic ear tag" for live-stock identification with large potential savings to the Montana livestock industry. Another project would identify high risk lightning areas where extra insulation is needed to protect transmission lines.

Energy Systems and Materials Engineering -- Montana's economy relies on abundant, economical supplies of energy. The need exists for more efficient and environmentally acceptable energy production methods, innovative uses of alternative energy sources and economic techniques for converting Montana grains to useful energy forms.

New technologies in materials are developing rapidly and Montana manufacturers must continually upgrade materials to stay competitive.

The EES will develop research programs in: energy systems, including modification of carbon-based fuels to chemical forms that are clearer and more efficient, an extension of solar test laboratory work, and materials engineering, new materials and their applications including coal-derived materials, catalysis, composite materials and coal-based carbon materials.

One project would seek new technology to more efficiently obtain fuel ethanol and other useful chemicals from grain or from timber industry residues. A second project would investigate the amount of solar energy collected during time periods when solar radiation values are theoretically below the level required to produce energy gain; improved solar heating design methods are expected. Requested biennium budget - \$1,067,380.

Water Resources Research Center (WRRRC) -- Federal support to the WRRC program requires a matching state commitment. Support requested by this modification will enhance the university system's role in helping to manage the state's water resources.

The WRRC's role in water management is three fold: 1) research that provides management tools to state water agencies, 2) training of professional people, and 3) information transfer. Requested biennium budget - \$120,000.

Alternative Uses of Agricultural Products (Agricultural Experiment Station) --

The economy of Montana would also greatly benefit by increasing the value by processing the products before shipping; in turn reducing shipping costs.

The Montana Agricultural Experiment Station has engaged in research leading to valuable products. Examples include new crop varieties with better nutritional properties, higher quality forage, and the utilization of distillers' by-products as animal feed and human food. Examples of potential new research areas include barley and wheat use in human food products, animal feed and new energy sources. Safflower varieties adapted for energy applications. Enhanced quality of specialty crops for small farms. Genetic engineering applied to Montana crop and livestock products.

A program leader in agricultural product utilization will be appointed and will undertake a research program. In addition, the program leader will encourage appropriate research proposals. Requested personal services support will include technicians, graduate students and hourly labor equivalent to five classified FTE. Personal services will be distributed on a competitive basis to support research. As projects are completed, the personal services support will return to a central pool for redistribution, again on a competitive basis. The leader will also actively solicit outside funds. Montana agriculture will be in a much better position to capture the potential offered by new science and technology if this research is supported. Requested biennium budget - \$398,000.

Business Development Assistance (Cooperative Extension Service) -- The Cooperative Extension Service's extension outreach network exists to reach into the business community to coordinate service, assistance and referral. Initially, federal funds were used to support business assistance provided through the network and, at one time, more than 12 such positions existed in Montana. Presently, outside the Build Montana program, only one part-time business assistance position exists with the extension service network. Federal funding for this position ends in December 1984. Therefore, in order to continue this type of support from the Montana Cooperative Extension Service, financial assistance will be needed to support one position in business assistance. Requested biennium budget - \$46,805.

UNIVERSITY SYSTEM

Modify Indirect Cost General Fund Offset -- In Montana, 85 percent of indirect costs reimbursements generated by research activities is used to offset the

general fund; 15 percent remains with the originating institution. Based on surveys of the universities in the west, the 85 percent general fund offset is excessive. This high general fund offset percentage is a disincentive for doing research.

The general fund offset should be well under its current 85 percent. The modification request moves the offset percentage from 100 to 15 percent. This will provide a means of sustaining research efforts in the Forestry Experiment Station, Bureau of Mines, and the Engineering Experiment Station and the MONTS Program. Strengthening these areas within the University System would help improve Montana's economic base.

Building Program -- The Advisory Council recognizes that expanded efforts in technical and scientific education and in research within the University require additional capital expenditures for workspace, offices, laboratories and classrooms. The Advisory Council therefore supports the funding of facilities, such as the Engineering and Physical Sciences Complex at Montana State University, the multi-use Technical Building at Northern Montana College, Havre, that provide and support training and education of scientists, engineering, and other technical personnel as well as providing research environment capable of supporting Montana industry.

Potential Economic Development Impact and Other Related Impacts

The university units must play a major role in the economic future of Montana. The use of knowledge, the diffusion of technology, and the stimulation of innovation have large potential for improving productivity and competitiveness for the Montana economy. Therefore, in the future, Montana businesses will depend even more on university units producing quality students in business, engineering and sciences, and having first rate research and business assistance programs essential

for the support and growth of existing traditional industries and advanced technology industries.

Implementation

The Montana Legislature is responsible for funding of these programs and building projects while the University System and its units are responsible for implementation and administration of the program.

RESEARCH CHAIRS TO SUPPORT COOPERATIVE RESEARCH

Description of Problem or Situation

A need exists to immediately strengthen the research capability of Montana in support of advanced technology economic development. Strong University System research expertise, working collaboratively with industry, is widely recognized as a key determinate in supporting existing industries and in the start-up and location of advanced technology firms. To obtain quality research expertise, the establishment of research chairs with competitive salaries is needed to support technology development.

Recommendations

Establish within the University System, a program of seven distinguished research chairs to support the R and D needs of existing industries as well as emerging advanced technology industries.

Potential Economic Development Impact

An infusion of nationally recognized scientific expertise into Montana's University System would be a major commitment to strengthening Montana's

position in advanced technology. This added expertise would be applied to strengthen R & D capabilities in partnership with existing business and industry and to encourage the development of advanced technology industry in the state.

Implementation

The Board of Regents and units of the Montana University System would implement the program. Research positions created and expertise sought would be decided by each participating unit with advice and guidance from representatives of the private sector and the proposed Science and Technology Development Board. Positions shall be created in technology areas targeted by the proposed Board.

Estimated cost is \$700,000 annually (\$100,000 for each chair). Industrial and business matching financial support of the program is expected. The establishment of research chairs is proposed to be funded from the proposed Science and Technology Development Institute's research capability investment program.

COMMERCIALIZATION OF UNIVERSITY RESEARCH

Description of Program or Situation

Montana State University (MSU) and the University of Montana (UM) are the two units of the University System that have some formal licensing program and procedures for commercializing marketable products or processes resulting from university research.

When a new product or concept with commercial potential is developed, UM either contracts with the Research Corporation, with offices in New York and Tucson, Arizona, or chooses to handle the patenting/licensing internally through the

Office of the Vice President for Research. The Research Corporation is contacted if the commercialization potential is particularly large, has the potential for litigation, or marketing is problematic. The Research Corporation has been approached by UM three times in the last five years and in each case has turned down the proposed product/concept.

MSU has organized the Research and Development Institute (RDI), a private non-profit corporation, whose objective is to provide support for the research mission and assist MSU personnel in licensing and commercializing products and concepts developed by them. RDI provides MSU with more control over the commercialization process. MSU had, in the past, retained the services of Research Corporation but considered the general level of service inadequate. RDI's Board of Directors consists of MSU personnel. It has no permanent staff; however, part-time legal services are acquired on an "as needed" basis.

No formal, system-wide policy exists within the University System to encourage commercialization of university research in Montana which would encourage entrepreneurial involvement of Montana businesses.

A subcommittee of the Advisory Council on Science and Technology concluded (a) that more University resources and funding must be devoted to commercializing university-related research; (b) that a more formal and aggressive approach to research commercialization is needed; and (c) that Montana businesses should have the first opportunity for commercializing university marketable research.

Draft Recommendation

Encourage the University System to: (1) examine critically existing patenting, licensing, and commercialization services and develop enhanced and more efficient means to provide these services within the entire University System;

(2) increase university wide support for patenting, licensing, and commercialization services; and (3) develop a systemwide policy requiring investigation of the opportunity and feasibility of licensing and commercializing university technology by Montana firms or Montana-based firms prior to contacting out-of-state firms. The policy developed should include a formal communications system to share the University System's products, discoveries, and other commercialization opportunities with Montana's financial and business community and to obtain from the business community ideas for additional research of interest to Montana business and industry.

Potential Economic Development Impact

University System research has brought several new technologies into the private sector. More new technologies and products are possible if university research capabilities are enhanced and utilized in partnership with business and industry. These partnerships would be supported by the programs of the proposed Montana Science and Technology Development Institute. Transferring new technologies and discoveries into Montana firms for their production and use strengthens and diversifies the economy of the state. Any one unique discovery or innovation has the potential for rapid growth and job creation.

Implementation

The University System and its units would be responsible for implementing the recommended commercialization policies and programs.

SCIENCE AND TECHNICAL EDUCATION

Description of Problem or Situation

With major shifts in our economy to more reliance on scientific and technical knowledge, it is important that citizens receive the training to provide skills needed by industries utilizing new advances in technology. In addition, the schools - K-12, Vo-Tech, Colleges and Universities - can strive to develop interest in technical and scientific careers and enhance overall scientific and technical literacy among all students. Adult education and other means can be used to improve the understanding of technology of the general public.

Recommendation

Teacher Training -- Those institutions training secondary teachers should examine, and strengthen, where appropriate, those elements which will enhance the preparation for teaching science, mathematics, and computer-related programs. At the same time, summer and/or continuing education programs for re-training present teachers in those areas, should be developed.

Vocational Education -- Support the development of vocational-training curricula which reflects emerging employment opportunities. The Vo-Tech schools and Community Colleges should be strongly encouraged to develop the systems and procedures which will permit them to quickly respond to identified, specific skill training requirements.

Skills Development -- Support greater emphasis on mathematics, science, computer literacy, communication skills, and entrepreneurship for technology-oriented programs in all grade levels.

Industrial Involvement and Support -- Support development of programs whereby industry can interact regularly with grade and high school officials to improve

and expand mathematics, science and technology education, strengthen the competence of teachers, and provide advanced technological equipment and facilities.

Career Opportunities -- Support programs that identify and familiarize students with career opportunities that are available as a result of new technological advances.

Information Networks -- The proposal of the information dissemination subcommittee to develop a statewide communications network for data access and delivery of continuing education offerings is strongly supported. In addition, support must be provided for the development of these program offerings.

Continuing Education -- Support expanding continuing education, evening programs, and other opportunities to serve adults seeking to upgrade, retrain, or become generally more knowledgeable about opportunities in advanced technology. The Board of Public Education and the Board of Regents should be encouraged to develop both programs and courses to enhance the understanding of science and technology in human affairs, both at secondary and post-secondary levels.

Potential Economic Development Impact and Other Related Impacts

Having a supply of well-educated students and trained workers is a prerequisite for advanced technology utilization and innovation by traditional and emerging industries. Strong education and training programs help assure that local students and workers can compete for technical positions.

Implementation

Board of Regents, Board of Public Education, Office of Public Instruction, university and college administrators and faculty, school boards, school administrators, and teachers.

RESEARCH/TECHNOLOGY PARKS AND TECHNOLOGY-BASED
NEW BUSINESS INCUBATOR FACILITIES

Description of Problem or Situation

Despite a mixed success rate, research/technology parks designed specifically for advanced technology research, development, and light manufacturing are proliferating and appear to be a key factor in creating a commercial climate conducive to the start-up and siting of advanced technology enterprise. Currently, no significant science or research and development parks exist in Montana that are specifically directed toward firms doing science and advanced technology development. This situation presently hinders development in Montana and will continue to do so unless remedied. Having research/technology parks in Montana in appropriate settings (particularly near universities and colleges) is a necessary component for advanced technology development to occur in Montana.

Advanced technology business incubator facilities (organizations created to nurture the start-up of new firms by providing, at reasonable cost, space and various shared business support and technical services) are being established to encourage the creation and successful initial operation of technology-based firms. Presently no incubator facilities exist in the state, clearly this restricts the opportunity to create new businesses and associated employment opportunities in Montana.

Two of the Council's subcommittees have identified research/technology parks and business incubator facilities as possible methods to encourage technology-based business development.

Recommendation

The proposed Science and Technology Development Institute and the Department of Commerce should work with the private sector, local development corporations, federal laboratories and the University System to evaluate the feasibility of research/technology parks and technology-based, small business incubator facilities as methods to encourage technology-based business development. Investments from the proposed Science and Technology Development Institute should be made available for feasibility studies and initial planning of possible research/technology parks and technology-based, small business incubators.

Potential Economic Development Impact

High quality, research/technology park developments offer a variety of advantages to start-up an established firm. They can provide the environment and location, with appropriate services and buildings, being sought desirable companies, both indigenous and expanding regional and national companies. These technology-based companies offer high growth potential, require skilled and educated workers, have minimal impacts, and create a need for support services provided by local businesses and universities. Research/technology parks can be a magnet for locating new and expanding firms.

Technology-based, small business incubators help entrepreneurs with new firms overcome the critical problems of finding affordable space and obtaining support services. By providing these needs the start-up of firms is encouraged and these new businesses are more likely to succeed and become established in local communities and hire local people.

Implementation

The proposed Montana Science and Technology Development Institute, the Department of Commerce, local governments, the University System, federal laboratories and the private sector should work to establish procedures and methods to determine feasibility and assist in the creation of research/technology parks and business incubator facilities in appropriate locations.

TELECOMMUNICATION CORPORATION

Description of Problem or Situation

Ready access to information, services and rapid communication is crucial to successful planning. In a large rural state like Montana innovative uses of telecommunications (interactive voice, data, facsimile, and video) can substitute for moving people. Montana has significant information, training and educational resources, but better access to these resources, particularly for people in remote areas, is possible. Additionally, Montana has a variety of information dissemination facilities and telecommunications systems that can be coordinated to the advantage of both the public and private sectors. A need exists for a comprehensive inventory and the planning, coordination, aggregation, and pooling of available telecommunications and informational resources, both public and private, into an efficient, modern system.

Recommendations

An integrated statewide telecommunications system is needed to provide a cost-effective means of electronic networking for public services, dissemination and private access to public resources. To do this a working partnership between

public and private telecommunications entities in the state should be established. A Committee of the Science and Technology Board should be formed to plan, develop and launch a private, non-profit corporation to provide telecommunication services to the people of the state.

Potential Economic Development Impact

An efficient statewide system of electronic networking would serve as a catalyst for economic development by providing timely access to necessary information and expertise. A partnership of government, private industry and educational interests in the state under the guise initially of the proposed Committee, and ultimately under the resultant non-profit Corporation could provide the organizational and financial mechanism needed to realize state-of-the-art telecommunications facilities, by utilizing leasing arrangements as well as private upfront capital investment, and by aggregating users and sharing facilities.

Implementation

The proposed Science and Technology Institute's Board would appoint a Telecommunications Development Committee to function for a period of two years. The Committee would be comprised of representatives of state government, educational interests, private industry and the general public with expertise and interest in telecommunications and information dissemination. The Committee would pursue two major activities: (1) in conjunction with the state Communication Bureau, plan the development of an efficient telecommunication system; and (2) create a non-profit corporation to coordinate the utilization of existing telecommunication systems as well as provide a means of developing new telecommunications capabilities. The Committee would design and implement the proposed corporation.

Cost

Two hundred thousand dollars (\$200,000) is needed to operate a telecommunication committee and to support the committees efforts to launch a private, non-profit corporation. Funding for the subcommittee should be an investment from the proposed Science and Technology Development Institute's technology transfer and assistance program.

APPENDICES

- A. DRAFT LEGISLATION
- B. SUBCOMMITTEE PARTICIPANTS
- C. SUMMARY OF SUBCOMMITTEE REPORTS
- D. INITIATIVES OF STATE GOVERNMENTS

INTRODUCED BY _____

BY REQUEST OF THE MONTANA ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY

A BILL FOR AN ACT ENTITLED: "AN ACT TO CREATE A MONTANA SCIENCE AND TECHNOLOGY DEVELOPMENT INSTITUTE, A GOVERNING BOARD, GRANTING RULE MAKING AUTHORITY, A MONTANA SCIENCE AND TECHNOLOGY DEVELOPMENT FUND, AND PROVIDING AN IMMEDIATE EFFECTIVE DATE."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF MONTANA:

Section 1. Purpose. Montana's economy has been weakened by recession, persistent inflation, high interest rates, high transportation costs, and foreign competition. The result has been economic upheaval, diminished markets, and significant loss of jobs.

Deteriorating regional and local economies throughout the nation and the world are prompting an unprecedented rush to diversify and revitalize state and national economies through public support for technological innovation. Montana can protect its economy from the competition of more knowledge-oriented, technology-intensive economic development elsewhere by actively participating in a long-term, statewide effort to expand technology-based business and industry. Increased efforts to utilize scientific knowledge, innovation and advanced technology can make positive long-term contributions to Montana's economic future. The revitalization of traditional industries, coupled with the emergence of new advanced technology industries, will mean more and better jobs for Montana workers and a revitalization of Montana's economy.

Public and private resources must be organized and invested in partnership to provide scientific and technological support for Montana industries and

businesses and to bring new technological opportunities to the state. To encourage and apply this public and private cooperation and investment in advanced technology development to Montana's traditional and emerging private sector firms, a Montana Science and Technology Development Fund is established. The fund is to be administered by a Board of Science and Technology appointed by the Governor. The board and the board's staff shall operate as an administrative body known as the Montana Science and Technology Institute. In addition to administering the Montana Science and Technology Development Fund, the Institute shall provide a forum for discussion and policy guidance for the Governor, the legislature and the public on the role of science and technology in maintaining and strengthening Montana's economy.

Section 2. Montana Science and Technology Development Institute. (1) There is a Montana Science and Technology Development Institute. The purpose of the institute is to contribute to the strengthening and expansion of the economy of the state through the development and application of science and technology.

(2) There is a Montana Science and Technology Development Board to administer the institute.

(3) The Montana Science and Technology Development Institute is allocated to the department of commerce for administrative purposes only as prescribed in 2-15-121, except that the board is authorized to hire an executive director and such other staff as may be authorized by the legislature.

(4) The board consists of nine members appointed by the governor under 2-15-124 except that for initial appointments to the board:

- (a) five members of the board shall be appointed to terms ending on January 1, 1987, subject to appointment and confirmation of their successors; and

(b) the remainder of the board shall be appointed to terms ending on January 1, 1989, subject to appointment and confirmation of their successors.

(5) In making the appointments, the governor shall consider people with a broad interest and experience in science and technology or economic development in Montana.

(6) The board is designated a quasi-judicial board for purposes of 2-15-124 except for 2-15-124 (1) and (5) shall not apply.

(7) Board members may not personally be applicants for or recipients of board funds. This shall not be interpreted to prohibit grants to university system units, businesses or institutions employing members of the board.

Section 3. Definitions. As used in (section 2 through 10), the following definitions apply:

(1) "Board" means the board of science and technology provided for in section 1).

(2) "Research and development project" means a project designed to discover, develop, transfer, apply or commercialize existing or new scientific and engineering knowledge in order to strengthen and enhance economic development in Montana.

(3) "Institute" means the Montana Science and Technology Development Institute provided in section 1.

(4) "Business and industry" means a privately owned and operated commercial enterprise or an association of the same that maintains a research, development, or manufacturing facility in Montana, although such enterprise or association need not have its headquarters within the state.

Section 4. Meetings. The board shall meet quarterly and at other times as called by the chairman or a majority of the board, subject to the availability of funds.

Section 5. Organization. (1) In addition to the chairperson, the board may establish other offices and select board members to fill such offices.

(2) The board may adopt procedures for the conduct of its business. These procedures are subject to the Montana Administrative Procedures Act.

Section 6. Board duties. (1) To the extent possible with available funding, the board shall:

- (a) identify priority scientific and technological opportunities related to the economy and resources of Montana and formulate proposals to develop those opportunities;
- (b) invest in research and technological development intended to improve competitiveness and productivity of existing Montana businesses, industries and agricultural producers; support the emergence of advanced technological industries that will make a positive contribution to the state's economic future, and that are compatible with the state's human and natural resources;
- (c) Invest in research with private business and industry, units of the university system and non-profit research organizations, located in or conducting business in Montana. Such investment shall encourage and support high quality scientific and technological research in subject areas that promote and enhance the state's prospect for economic development.
- (d) Formulate and employ mechanisms to generate income derived from the sale or licensure of products, technologies, processes, concepts or intellectual assets, having commercial value and which are developed as a result of the state's success and technology investment programs.

- (e) Invest in non-profit research organizations, universities, and colleges who in cooperation with business and industry wish to create, improve and strengthen research and development capabilities in existing and new scientific and technological areas that can best nurture the economic development of the state.
- (f) Invest in programs to create, improve and strengthen technical assistance, technology transfer and research commercialization opportunities for Montana businesses, industries, and agriculture producers.
- (g) Invest in programs to establish cooperative associations and consortia of state research facilities and private business and industry for the purpose of engaging in coordinated research and development programs that will aid the creation of new jobs in Montana.
- (h) Assist and provide state resources to establish projects in scientific education and training which support the application of advanced technology by business, industry, and agriculture and accelerate the development of a technology-intensive economy.
- (i) Share investments, through financial intermediaries with money-at-risk, in financing the start-up and product development work of business and industry in Montana engaged in developing and marketing new products and processes.
- (j) Advise universities and colleges of the research needs of the private sector and foster the exchange of scientific, technological and entrepreneurial information for the purpose of economic development.

- (k) Obtain and disseminate information from the state's scientific and technology-based businesses, research and development organizations, programs, and projects. Such information shall be utilized to illustrate Montana's scientific and technological capabilities, and to guide and formulate policy for furthering advanced technology enterprise and industrial research and development.
- (l) Establish a telecommunications committee for the purpose of forming and organizing a private non-profit corporation within two years. The purpose of the new corporation shall be to establish leadership in the use and coordination of advanced telecommunication resources of the public and private sectors to support rural and urban economic development.
- (m) Invest in a program of seven distinguished research chairs within the University System to support research needs of existing industries as well as emerging advanced technology industries.
- (n) Other duties as necessary.

(2) The board shall submit to the Governor and the Legislature a report describing the board's programs and accomplishments by November 1 of each year. The report shall include board recommendations relating to science and technology development in Montana and summarize projects funded by the board.

(3) The board shall at the end of the fifth and tenth year of operation provide for an independent review of the Institute's effectiveness in improving the state's economy.

Section 7. Establishment of an investment fund. (1) There is hereby created a special investment fund in the state treasury to be known as the Montana Science and Technology Fund. The fund will receive a transfer of \$6 million annually, for ten years, from the Coal Tax Trust Fund.

(2) The board shall provide investments from the fund for economic development in the following areas:

- (a) Providing investments in research projects supporting new and emerging industries.
- (b) Creating and strengthening existing research capabilities and programs in the State in areas of economic development potential.
- (c) Establish and strengthen programs providing technology assistance and transfer services to business and industry.
- (d) Invest through financial intermediaries with money-at-risk in early stage.

(3) The Fund shall support administration of the board and the staff.

(4) All royalties, interest and other income received by investments in the board shall be deposited in the fund.

(5) Appropriations to the Institute and investments made by the board will be in addition to, and separate from, general fund appropriations to the University System.

(6) The board may:

- (a) Accept grants or receive bequests of money or property from private or public sources to be used in Montana to make investments described in Section
- (b) Manage property subject to its control.

- (c) Receive royalties, interest, or other considerations that result from projects it has funded.

(7) Funds obtained pursuant to this section or from the sale or management of property obtained pursuant to this section shall be placed in the Montana Science and Technology Development Fund.

Section 8. Powers related to disbursing funds. The board shall (1) establish appropriate policies and procedures.

- (2) Make investments.
- (3) Appoint staff.
- (4) Carrying out the duties as required in this law.

Section 9. Basic funding. (1) The investments permitted in Section 7 may be made only for projects conducted primarily in Montana or that will substantially strengthen economic development in Montana.

(2) In making investments, the board shall:

- (a) solicit proposals and perform competitive review;
- (b) give priority to Montana persons, business, corporations, universities and colleges;
- (c) give priority to investments that represent cooperation or partnership between the private sector and universities or colleges;
- (d) consider the extent to which the proposed project or program is likely to contribute to economic development prospects of the state;
- (e) establish matching criteria for research investments;
- (f) evaluate the competence of professional personnel responsible for conducting projects as evidenced by academic training, research experience and publications, or demonstrated expertise or experience;

- (g) evaluate the soundness of project implementation plans, evaluation systems and the likelihood of achieving project objectives;
- (h) assess the commitment of financial and personnel resources made by those seeking research funds;
- (i) evaluate the potential of the project for attracting support from non-state sources;
- (j) establish peer review procedures for scientific merit of;
- (k) determine the extent to which the proposed research will strengthen an established institutional base or create a new research capability in a priority scientific or technological area;
- (l) assure that capability grants to institutions will enhance research capabilities in a priority scientific or technological area; and
- (m) avoid duplicating existing capabilities, programs and projects.

(3) The board shall consider, but is not to be limited by investment recommendation of any technical advisory committees created pursuant to (Section 11).

Section 10. Accountability. (1) The board shall develop independent review and audit procedures to insure that investments made by the board are used for the purposes identified in applicant proposals.

(2) The board shall condition investments in such a manner as the board considers necessary to secure inspection and review, accomplishment of project results, attainment of project goals, and adequate financial records.

Section 11. Technical advisory committees. (1) The chairman of the board may appoint technical advisory committees. Members of technical advisory

committees serve at the pleasure of the chairman and operate under such procedures as the board may prescribe. In selecting committee members, the chairman shall give consideration to the scientific and technological expertise of the members and seek representation as appropriate from the scientific and academic community, from business and industry, agriculture, and the general public.

(2) Committee members are entitled to receive reimbursement for travel expenses, as provided in 2-18-501 through 2-18-503, but may not receive any additional compensation for committee services.

Section 12. Rulemaking authority. The board may adopt rules to implement the provisions of this act. Rules adopted by the board may include definitions of eligible research and development, small- and medium-sized businesses, a method of committing funds, types of fees, and types of research investments to be made. The board may also adopt procedural rules to govern its proceedings.

Section 13. Effective date. This act is effective on passage and approval.

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ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY
SUMMARY OF SUBCOMMITTEE REPORTS
OCTOBER 1984

AGRICULTURE TECHNOLOGY

The subcommittee proposes to strengthen agriculture research. Scientists are available to carry out an expanded research program in new areas but additional funds are needed for operations, personnel, and capital investments.

A Board of Science and Technology is proposed to provide grants to support research and technological advances. Also University scientists working on agricultural related research at MSU have discoveries that have commercial application. Having no entity in the state designed to move research projects to the market place is a problem. Montana needs a single entity to coordinate research and development, and available funds to help move new innovation to the market place.

Also proposed is a program to find more ways to utilize Montana's agricultural products and/or enhance the products before they are exported from the state. Developing industries that will refine the agriculture products would improve the agriculture economy and provide jobs for more Montana people.

BIOTECHNOLOGY SUBCOMMITTEE

This report consists of three recommendations. The first one is to establish a permanent Board of Science and Technology. It would be responsible for conferences, trade shows, directories, patenting procedures, a grants program, and encourage the establishment of new business.

The second recommendation is to establish a Biotechnology Center and incubator facilities. Details on the kind of facilities needed would be left to a permanent board of Science and Technology. The needs of new research capabilities or an administrative center for fostering the exchange of biotechnology information between industry and the academic community will be considered.

The third recommendation is to have the state sponsor R&D limited partnerships for funding technology to where it becomes a revenue-producing activity. The committee believes state sponsorship would address the serious capital shortage problem. The stage of R&D in most need of financial help is between the idea or patent and the point where it is clear that the business will become commercially viable. State funds are needed for this stage of R&D and can be used to match funds from private investors.

SUBCOMMITTEE ON COMPUTERS, ELECTRONICS,
AND MATERIALS SCIENCE

The subcommittee's report consists of ten recommendations.

1. Establish a program for the coordination, access, and dissemination of information, data, activities, facilities, expertise, etc. There is a need to provide awareness of available programs and technology data bases.
2. Establish entities whose purpose is to move basic research ideas towards commercialization. These entities should facilitate the interactions among industry, business, government, and universities. Focus should be on technology transfer, extension, and product development.
3. The state should support non-directed research in areas of strength in the university system, particularly those relevant to future technologies.
4. The state establish one or more "Technology Research Centers," and that one of these centers be established at Montana State University in the area of Advanced Materials Synthesis and Characterization.
5. It is necessary to develop physical facilities to meet the expanding role the universities will play in a "Build Montana" program. The universities do not have adequate space for their own programs let alone for additional activities.
6. The state must foster, promote, and support the concept of lifetime learning. There is need for continuing education particularly in the hi-tech businesses which must maintain a competitive edge. Perhaps tax incentives for businesses and additional funding for universities will be necessary to encourage this activity.
7. Active, aggressive, educational and public relations programs to change attitudes towards doing high technology in the state of Montana need to be undertaken. All citizens need technology awareness to encourage technological evolution in the state.
8. The Council should promote meetings of interested parties throughout the state related to questions of computers, computing, and computer science. An unhealthy competition and a lack of interaction among the units of the university system seems to exist, particularly in computer course offerings and degree programs in computer science. The next generation of mainframe computers should be located at one point in the state with access from university, government, and business.
9. A Montana electronics and computer trade booth should be prepared by the Department of Commerce to send to the trade shows around the country. In addition, the Department of Commerce should sponsor an in-state conference of all parties interested in computers and electronics. A possible outgrowth of such a conference would be a Montana-based trade show.
10. University researchers must be provided with more flexibility and incentive in obtaining reimbursement from activities on research projects. The present summer salary restriction is a serious impediment to keeping faculty on campus working on projects of interest to industry.

ENERGY AND ENERGY CONSERVATION SUBCOMMITTEE

It is the recommendation of this committee that the resources of the state be directed toward developing the research and technology base of our natural resource industries as they are related to energy and energy conservation.

To accomplish this, the subcommittee recommends the establishment of a research and development agency to foster and initiate research and development activities in those areas that are critical to encouraging economic growth in the field of energy production, energy conservation and renewable resource development.

The agency would receive a budget from \$2 million to \$5 million per year to carry out its R&D goals. This budget should consist of as much private funding as possible with the balance from the State. Another approach might be for matching state government funds (50% by the private sector, 50% by government) with the benefits being jobs and opportunities in Montana.

Following formation of an appointed Council on Science and Technology, some preliminary R&D goals recommended by this subcommittee for consideration by the Council and the "Agency" are as follows.

Methods must be explored that seek to reduce the costs of transportation for the carbonaceous fuels in Montana. Among the recommendations for investigation are: Coal beneficiation, coal liquification, methods of acceptable coal slurry transportation, production of synthetic fuels and coke, drying and pelletizing of lignite, and reduction of mineral content of coal.

Additionally, expansion of research into other areas of increased coal utilization efficiency with minimal environmental impact is recommended. These include: Commercialization of MHD technology, acid rain reduction technologies through increased scrubber efficiencies, and clean, small coal combustors for residential use.

The recommendations for oil and gas R&D are investigations into: development of oil shale, recovery of oil and gas from non-conventional sources, cogeneration systems to efficiently utilize oil and gas resources, and enhanced recovery systems for oil and gas.

With the vast renewable resource potential of the state, the subcommittee recommends that renewable resource investigations and development become a keystone in the development of the energy systems in Montana.

Methods and mechanisms must be found to reduce the cost of transportation of our products to market.

Additional research is needed into: uniform building codes to insure they are as energy efficient as possible based on future energy prices, and cost effective superinsulation techniques for existing structures.

FINANCING AND COMMERCIALIZATION OF RESEARCH AND SUBCOMMITTEE

The subcommittee made four basic recommendations. The first is to encourage the University System to increase support for patenting, licensing, and commercialization services. A formal communication link should be established between University commercialization services and Montana's financial and business community designed to share information about University patenting and licensing activities.

Second, a program should be implemented to invest either Board of Investment funds or Montana Economic Development Board funds in Montana Capital Companies or Montana-based SBIC's under terms allowing for use of these funds in early-stage financings. Also the legal issues concerning fiduciary responsibilities of these Boards should be studied.

Third, establish financial incentives for the private sector or local economic development entities, to establish and operate no more than three incubator facilities.

Last, analyze Montana R&D investment tax laws to identify differences between Montana laws and those in other Rocky Mountain states and for consistency with federal laws.

FORESTRY SUBCOMMITTEE

Montana's business climate for forestry-related activities is deteriorating. The cost of doing business in Montana is higher than competitive states because of transportation costs, taxes, environmental regulations, etc. A better analysis of forest management costs and values is needed. More information is needed on the supply and long-term potential productivity of wood, water, wildlife, forage and recreation on all lands. Improved multiple-use management strategies need to be developed and more economic harvesting and utilization systems are needed.

Four recommendations were made by the subcommittee:

1. The State's mission-oriented forestry research program is centered at Lubrecht Experimental Forest. Expansion of this research program is essential to develop improved technologies for resource management and the wood products industry. The State needs to encourage federal and private research support to promote stable cooperative solutions to priority resource management problems.

2. Timber resource supplies must be identified and projected to enable land managers to develop long-range plans.

3. A standardized mechanism to communicate research results, legislation, and other important information must be developed and implemented.

4. Steps are needed to create a more favorable business climate through appropriate legislation, favorable tax structure, and promotion of resource-related assets.

INFORMATION DISSEMINATION SUBCOMMITTEE

A general statewide needs assessment was conducted by the Cooperative Extension Service and it was determined that over half of the problem-solving recommendations, particularly those concerning access to information, could be accomplished through telecommunications applications. The primary need appear to be not in developing new information resources but rather better access to the existing resources.

Two proposals were submitted by this subcommittee.

First, that a statewide science and technology information service be created to facilitate technology, transfer and promote economic development by providing access and referral to key sources of information and services. The state should provide a clearinghouse for information services and research resources available in the state as well as nationally. A central office should be designated to act as an information consumer advocate and referral service. The office should also act as an advocate for further development of information services and systems.

The second proposal is that an integrated statewide telecommunications system should be developed to provide a cost-effective means of electronic networking for public services dissemination and access to public resources. The state should lead the planning, development and implementation of such a system but it should do so in a partnership forum with the telecommunications industry.

SUBCOMMITTEE ON MINERAL TECHNOLOGY

The mineral industry, which includes coal, metals, nonmetals, oil, and gas, contributes significantly to the economy of the State of Montana through tax revenues and jobs, and indirectly through the growth of local businesses. Many complex issues are associated with the industry. For example, a number of economic factors, such as capital costs and commodity pricing, influence the viability of a project. Technology plays a crucial role in exploration, extraction, and production of a particular mineral, and research and development, in areas like geophysics and geochemical techniques, aids in mineral discovery.

Because the mineral industry is so important to Montana, state and private sector partnerships must be formed to design and carry out new programs in response to the industry's needs. The Subcommittee on Mineral Technology has outlined several policy goals for adoption by the Governor's Council on Science and Technology, and has specifically identified program initiatives that could be undertaken through public/private sector cost sharing.

The minerals industry offers the state the opportunity for continued economic growth. In order to strengthen the mineral industry in Montana and ensure its future, the state must invest in the scientific and technological development needed to enhance our regional mineral industry.

SUBCOMMITTEE ON TECHNICAL EDUCATION

Montana's present educational infrastructure includes provision for the "traditional" range of training for science and technology fields:

Preparation for career training (K-12)

Recent actions of the Board of Regents, Board of Public Education, and some local School Districts have resulted in improvements.

College - University career training

There is a good distribution and coverage of the traditional fields, as well as mathematics, computer-related programs, and businesses.

Vo-Tech Skill training

There are a wide range of offerings, primarily in traditional historic demand fields - although some new-technology programs are beginning to surface.

It is the non-traditional types of education and training, continuing education, and re-training, where there is an unmet demand, now, and even greater demand expected in the future.

There is a general shortage of qualified, secondary level mathematics, computer and science instructors. Further, many now teaching these subjects may need to be up-dated to present-day "state-of-the-art." Recent actions by the Board of Regents and the board of Public Education may hasten response to these concerns.

A related concern of the subcommittee is having a reasonable level of science and technological literacy among the citizens of Montana. This comes from a recognition that informed governmental and business decision making is only possible if the decision-makers have a grounding in the basic fundamentals of science and technology.

The subcommittee made four general recommendations.

1. Those institutions training secondary teachers should enhance the preparation for teaching science, mathematics and computer-related programs. At the same time retraining for present teachers in those areas should be developed.

2. The proposal of the information dissemination subcommittee to develop a statewide communications network for data access and delivery of continuing education offerings is strongly supported. In addition, support must be

provided for the development of these program offerings.

3. The Vo-Tech schools and Community Colleges should develop the systems and procedures which will permit them to quickly respond to identified, specific skill training requirements.

4. The Board of Public Education and the Board of Regents should develop programs and courses which enhance an understanding of science and technology in human affairs, both at secondary and post-secondary levels.

MONTANA ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY
INITIATIVES OF STATE GOVERNMENTS FOR TECHNOLOGY-BASED
ECONOMIC DEVELOPMENT: AN OVERVIEW
October, 1984

INTRODUCTION

The National Governors' Association (NGA) Task Force on Technological Innovation observed that:

"State governments are critically situated to encourage and facilitate the process of technological innovation. They directly influence the quality of ... education and manpower training that is essential for development of human scientific and technical resources. They support the vast majority of the nation's public institutions of higher education where most university research and development takes place. They provide significant technical, management and financial assistance to new and existing technology-based firms from which innovations to the marketplace flow. Equally important, state governments are in a position to build the kind of partnerships with education and industry that stimulate innovation and help ensure its continued vitality and relevance."

Encouraged by the opportunity that technology offers in economic development, state governments are joining with the private sector, universities, and local governments to encourage technology application to modernize existing industries and to promote new technology-based business ventures. Many new partnerships initiatives have been initiated by state governments and a brief synopsis of some of these programs is provided.

STATE INITIATIVES IN TECHNOLOGY

Alabama

The Alabama Research Institute was created by the Governor in 1983 and appropriated from the general fund of the state was ten million dollars (\$10,000,000) for the support and encouragement of educational, agricultural, maricultural and industrial activities involving basic and applied scientific research and development. The appropriation was made from moneys derived by the State from the leasing of rights in offshore oil, gas and other hydrocarbon minerals. The Institute makes grant awards as follows: Research Program Grants to support basic and applied research. Matching funds are not required for Research Project Grants, but such grants may be used cooperatively with funds from other sources. Institutional Challenge Grants shall not be project-oriented, but will seek to support institutional plans for permanent and significant enhancement of research capabilities in areas of potential economic significance to the state. An institution is required to match, dollar for dollar, a Challenge Grant award. Challenge grants may be used for such purposes as purchasing major items of research equipment, establishing centers for scientific research or endowing research chairs at an institution.

Arizona

The Center of Excellence established in 1980 at Arizona State University is designed to link industry with university resources, and to improve education in math, science, and computers. A total of \$32 million in public and private funds have been provided; the state's contribution consisted of a new building plus equipment for the engineering school.

California

The Microelectronics Innovation and Computer Science Research Program (MICRO) was established in 1982 by the California legislature. Current funding is \$2 M per year; every project must have at least 50 percent of its cost covered by industry.

Objective of MICRO is to help the California electronics and computer industries maintain their competitive edge by expanding research and graduate-student education at the University. Under the research part of the Program, faculty members on the several campuses submit proposals for research projects that will potentially be the basis for new industrial products some years in the future. The State and industry jointly support funded projects. Graduate-student education is supported both through research assistantships funded by the projects and through Fellowships granted directly to students in the fields covered by MICRO.

The Program is under the overall guidance of a Policy Board, composed of three representatives each from Industry, the State Government, and the University.

Colorado

A Colorado Advanced Technology Institute (CATI) has been created by the Legislature. The Institute provides incentives to attract top faculty, increase research capabilities, and would improve the quantity and quality of university graduates in technological fields. CATI is requesting \$7 million from the Legislature for FY '85.

Florida

The Florida Commerce Department's Research and Development Commission provides incentives for R&D parks to be built in conjunction with state universities. Parks presently exist at four of the state's colleges. The University system set up an Industrial/Academic Council to coordinate engineering education at the state's schools. The Council also provides linkages between programs and industrial needs.

Illinois

The Legislature created a fund known as the Technology Innovation and Commercialization Fund to be used to issue grants to universities and Illinois businesses for the purposes of fostering research and development in high technology and the services necessary to the development of new products which would be marketed by in-state businesses.

A Biomedical High-Tech Research Park is being built near Chicago to serve as a research center and incubator facility. The state has committed \$11 million to the project. Development of a Microelectronics Center at the University of Illinois is being planned, with an expected state investment of \$5.3 million.

Indiana

The Indiana Legislature established in 1983 the Corporation for Science and Technology (CST), to stimulate the development of new technologies, new processes and products and in the long run providing new employment opportunities. It is an independent, not-for-profit organization and performs three major functions: 1) provides policy guidance for the Governor and legislature on the role of technological innovation in strengthening Indiana industries; 2) develop programs to encourage innovation and technology; 3) provide a mechanism for the implementation of programs either through its own membership and funding or through the development of other resources.

In the 1983-1984 biennium, CST receives \$20 million from State appropriations. These funds are to be delegated at the rate of \$5 million for our first year and \$15 million for the second year. Thereafter, it is expected that CST will receive \$20 million per year for the rest of the decade. The Administrative budget for CST operations for the first year is \$400,000.

CST has a 24-member Board of Directors comprised of eight representatives each from the private sector, public sector, and university/education sectors.

Projects and programs of CST include:

- grants to universities for research that aids in the economic development of the State;
- "seed money" for organization and implementation of one or more Industrial Technology Institutes;
- matching funds for basic and/or applied research in targeted technologies to be managed jointly by universities and industry participants;
- preparation and consideration of proposals for research parks;
- matching funds to organize and start technology centers in various parts of the state; and
- creation and implementation of programs in conjunction with the National Science Foundation and/or other federal agencies.

The Corporation for Innovation Development (CID), a venture capital corporation established in 1981, is designed to: encourage capital investment in Indiana, encourage expansion of business and industry, provide additional jobs, and encourage research and development. CID is a private for-profit corporation authorized to invest in new ventures and businesses unable to obtain financing from other sources and to invest in Small Business Investment Companies (SBICs). The Corporation is authorized to sell stock to private investors who will receive a 30 percent credit against their income tax liability. A proposal to allow the state's pension fund (Public Employees Retirement Fund) to invest up to five percent of its assets in debentures of CID was included in the Governor's economic development package which was presented to the General Assembly in 1983.

North Carolina

The Research Triangle Park was started in the late 1950's, and a Board of Science and Technology with the governor as chair has existed since 1963. Two current programs are of particular interest.

The smaller is the North Carolina Biotechnology Center, started in 1981. It conducts R&D and coordinates university/industry activities. State support to the Center in 1983 was over \$100,000.

The most publicized is the Microelectronics Center of North Carolina, based in the Research Triangle. Begun in 1980 it has received over \$43 million in state funds. State support for construction equipment, and operating expenses leverages funds received from industrial affiliates - funds that go into directed research. It provides advanced training and research in fields related to computers and electronics.

Ohio

A long-term program for a strategic planning process has been started to carefully assess the state's problems and assets and to carefully target the state's limited resources. Ohio is committed to making the long-term investments required in state businesses, new ideas, skills and education, infrastructure and natural resources. Indicative of this approach is its \$32 million Thomas Alva Edison Partnership Program. The program will provide grants for both early- and late-stage research and development, direct technology audit and search programs, to accelerate the commercialization of new innovations, and set up major technology application centers at state universities.

In July 1984 that Ohio will award \$23.6 million for the establishment of six advanced technology application centers. Participating private sector firms are expected to match the state commitment, pushing the total investment in the centers to over \$47 million.

The centers will involve five major universities, and concentrate in welding and computerized information systems; advanced manufacturing; polymers; and recombinant animal biotechnology.

Calling the centers "a partnership between education, private enterprise and this administration," Governor Celeste maintained "they will focus our attention and resources on programs with real capability for creating jobs."

Massachusetts

The Massachusetts Technology Park Corporation, established in 1982 with \$20 million in state funds, is designed to improve ties between universities and industries and to establish training programs in emerging technologies. Current efforts are focused on microelectronics.

Michigan

The Industrial Technology Institute in Ann Arbor is designed to coordinate work by industries, universities, and community colleges in computer-based manufacturing, robotics, and retraining. \$2.75 million in state funds were provided.

The University of Michigan has established an Innovation Center which transfers new knowledge to existing firms so they can expand into new markets or products.

Wayne State University in Detroit has set up a Metropolitan Center for High-Technology. It has four main components: an expanded R&D capability, improved teaching facilities, an incubator program for new firms, and an industrial training and retraining program.

Michigan State University has started a Molecular Biology Institute, using a combination of state funds and foundation grants. It will undertake a wide range of projects, with particular emphasis on those capable of early commercialization.

Pennsylvania

The Ben Franklin Partnership Challenge Grant Program provides matching state funding to consortia of Pennsylvania's research universities, other higher education institutions, business, labor and other groups and organizations through four regional advanced technology centers.

Each center provides:

- joint R&D efforts, in concert with the private sector, in specified areas such as robotics, biotechnology and CAD-CAM. (Areas vary by center.)
- education and training, assisting all higher education institutions to provide training and retraining in technical and other skill areas essential to assisting firm expansions and start-ups.
- entrepreneurial assistance services including linking R&D, entrepreneurs, venture capitalists, and other financial resources; assisting in preparation of business plans, feasibility studies; etc.

Additionally, centers may, optionally, provide small business incubator spaces and services, technology transfer activities and other services.

Each center was provided a \$250,000 grant for the first six months of effort. The \$1 million State funds generated \$4.1 million in private and university matching funds. The Governor's 1983-84 budget proposal includes a \$10 million annual appropriation for the centers. The State funds are expected to generate \$10 million in additional private and university funds.

Texas

Texas A&M has established the Institute for New Ventures in New Technology (INVENT). This program links university R&D efforts with entrepreneurs, and provides information on product financing and marketing.

CONCLUSION

As the foregoing suggests, numerous mechanisms for state government, industry and university cooperation currently exist and are presently being developed by state governments around the country. The Governor's Advisory Council on Science and Technology is developing recommendations for a program in Montana.

